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A SKETCH OF
THE PANAMA CANAL
ITS
PAST, PRESENT AND POSSIBLE FUTURE

January, 1908

JNO. F. STEVENS

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A SKETCH OF THE PANAMA CANAL ITS PAST, PRESENT AND POSSIBLE FUTURE.

The conception of the possibility of uniting, by artificial means, the waters of the Atlantic and Pacific oceans, was a resultant of the many, and often visionary projects entertained by the bold, and generally unscrupulous spirits who not only ruled Spain when she was at the zenith of her power, but carried her flag and prestige to all parts of the New World, as it was then known. With few exceptions, every agitation, great or small, of any part of the human race, which has culminated in a movement to seize, explore and hold distant regions by force of arms, has been dictated by avarice. The fabulous reports brought to Spain by Columbus and by the early adventurers who followed him, of the wealth in gold, silver and precious stones in the new countries, raised up a horde of legalized bandits, whose exploits history has, with more or less accuracy, set forth.

Columbus, as we know, died without knowledge of what lands he had touched, believing them to be a part of what was then popularly called Cathay, or what is now known as the East Indies. Balboa, by his trip into the unknown wilderness, first demonstrated that, beyond the lands so far only really seen from a ship's deck, there existed another body of water, which was finally proven to dwarf the Atlantic in size, and which was separated from it, by only a comparatively narrow strip of land. Balboa early fell a victim to the jealousy of his fellow-adventurers, was not permitted to live to extend his discoveries, but he was followed by others as enterprising and unscrupulous.

The timbers of the first ship which plowed the waters of the Pacific Ocean, manned by white men, as far as history, or tradition, if you please, tells us, were laid in a small bay on the southern side of the isthmus of Darien, by one of these adventurers, and these timbers were cut on the shores of the Atlantic, hewn into shape and carried across the isthmus to the shore of the Pacific, and were there put together for the first voyage into the unknown sea. This work was performed by natives, seized and held as slaves by the Spaniards, whom without such enforced labor could have done little, but whom with the cross in one hand and the sword and torch in the other, forced the civilization of mediæval Europe, onto the greater part of the new world.

It is a far cry from the vision of this small band of Spanish explorers, taking a month with their miserable slaves to carry their small ship across the isthmus, to the vision of some future great admiral, steaming with a fleet of modern war ships, manned by the pride and glory of the United States, making the same trip in 8 hours—but the latter is a prospect that should be realized within a comparatively short time.

The conquests of Peru, and the spoliation of her wealth by Pizarro and the men who followed him, are matters of history. The most natural route by which all the spoils of conquest, which were claimed by the Crown of Spain, could be sent home was by the west coast of South America, thence across the isthmus and over the Atlantic to Spain. This practice, with the necessity for a port on the south side of the isthmus brought into existence the city of Panama, and from Panama northward across the isthmus, the Spaniards constructed a road, paved with stone, wide enough for two heavily laden mules to pass, and over which for years crossed and re-crossed the pack trains, which kept open the lines of communication between the Pacific Ocean and the plate ships of Spain. This old road still exists, and the writer has traveled over miles of it still in fairly good condition, and giving ample evidence of the thoroughness with which such works were then carried out.

All of these millions of treasure did not reach Spain: Panama in those early days was accounted the richest city on earth, in proportion to the number of its inhabitants, and we can be well assured that it took full toll of all treasure passing its portals. Then, too,

the English lay in wait, by trail and on sea, and Drake, Hawkins, Morgan and the rest, played the part of the eagle to the fish hawk, robbing the latter early and often of his prey. Buccaneer Morgan finally captured the original city of Panama, burned it, butchered many of its people, and scattered the rest into the jungles, from which years afterwards they collected and built the city of Panama which now exists, and which is near the south end of the canal now under construction.

History alleges that the idea of cutting a ship-way across the isthmus, to avoid the long and dangerous passage around the Horn, took shape in those early days, even going to the extent of carrying out of extensive explorations to select a feasible route. Be that as it may, nothing tangible resulted for more than 300 years. Possibly, this delay can in part be explained by an edict, which it is said that Philip the Second promulgated, that of prohibiting any Spanish subject from even mentioning such a project on penalty of death, and which edict, it is said, has never been revoked, and there are yet people who point to this law, as a proof of the great wisdom of Philip—a claim which the writer is not prepared to dispute.

Lord Nelson suggested a canal at Nicaragua in 1780, and early in the last century Baron Humbolt is said to have mapped several routes, one of which, was over the line practically now adopted. Spain also woke up again along in 1820 and talked canal, but as she lost control of the isthmus about that time, she did nothing. Along about 1840 several of the Central American states tried to interest Louis Phillippe in the project, but without success. The rush of travel and business resulting from the discovery of gold in California in 1849, so stimulated interest until as a consequence the Panama Railroad was built and opened in 1855. From this time on, different schemes were proposed, and in 1879, the French becoming interested, surveys were carried on by Lieutenant Wyse, a Frenchman, who a year before had secured a concession from Colombia to build a ship canal.

Ferdinand DeLesseps, with the prestige of, and fresh from the completion of the Suez Canal, took up the matter, and a congress convened by him in Paris decided in favor of a canal from Limon Bay (Colon), on the Atlantic side, to Panama Bay on the Pacific side. This Congress also decided a sea-level canal should be the type to be built.

Previous to this time, in 1852, the United States had undertaken and carried out at spasmodic intervals, surveys for a canal at Nicaragua, and in 1889 an American company was formed for the purpose of constructing a canal, along the lines developed at the latter place, but nothing of practical importance was accomplished, beyond the completion of surveys.

Attention had also been called to what is known as the Darien Route, some 100 miles eastward from the Panama Route, and it has been thoroughly reconnoitered, though no close instrumental surveys have been made.

Some features of this route are favorable: There are fairly good harbors at each end, and it is the shortest route across the isthmus, of any of the three which time and study have selected as the only ones worthy of consideration, but its adoption necessitates the construction and maintenance of a tunnel nearly five miles long—a proposition which owing to its size and importance, and the difficulty of securing an absolutely safe and sound roof, it is believed our best engineers would hesitate to endorse. Still, the Darien Route has its able advocates—some yet on the floor of Congress.

Right here, the writer gives as his individual opinion, that granting an inter-oceanic canal is to be built, that physically, financially, and for all other reasons, and after all arguments are balanced, the decision choosing the Panama Route, so-called, is the correct one.

In 1881, after organization and preliminaries had been attended to, active operations by the DeLesseps Co.—it having secured the Colombian concession from Lieutenant Wyse—was begun. The Canal Company purchased the Panama Railroad from the company which up to that time (1882), had owned and operated it. Besides, from its location, laying as it does, not only along but upon, in a number of places, lands actually needed for the construction of the canal, its importance as an adjunct to, as furnishing the necessary means of transporting not only the supplies over, but the waste material from the canal prism, its control by the canal builders became—and is yet—an absolute necessity.

The history of the DeLesseps attempt to build the Panama Canal is set forth at such length and in such details in various publications that a lengthy resumé of it here is unnecessary.

As noted previously, the original decision was for a sea-level water-way, but as time went on, as vast sums of money were raised and spent without commensurate progress, it was decided to abandon the sea-level idea and substitute locks, and to the trained eye of an engineer the history of those years, as money became harder and harder to raise, is plainly written on the face of the work. First a two-lock plan was attempted, then more and more locks were added, until the holes in the ground for these locks, which the writer found, apparently increased in number as the bank account grew less—a pathetic story, needing no words to understand.

In 1888, the company broke with a crash that attracted world-wide attention, and which before its echoes died away dragged many a name before honored, into the dust and undoubtedly hastened De-Lesseps' death. At the time of cessation of the work, it is likely more than \$250,000,000 had been spent, and conservatively not over 1-6 of the actual work had been accomplished. And fully more vital, a satisfactory plan to care for the most important, in fact the one prominent engineering feature of the whole enterprise—the control of the Chagres River and its tributaries, had not been solved or adopted.

In 1891, the company having been reorganized, an extension of the concession was granted by the Colombian Government, and work was again begun, and continued in a very small way—just enough to hold the concession—until the United States took over from the new French company all its property, plant and interest in the project, by the payment to it of \$40,000,000, which arrangement, all things considered, was a fair, without being a great bargain for the United States.

As certain rights and privileges not held by the French company, and consequently not transferred to the United States, were considered necessary, negotiations looking to the making of an arrangement with Colombia, were begun, and after long delays a fairly satisfactory treaty was formulated, which, however, was rejected by Colombia in 1903—quite unexpectedly, it is said, by the officials of the United States. But by a curious coincidence, shortly after the rejection by Colombia of the proposed treaty, the Province of Panama, an integral part of Colombia, seceded from its allegiance to, and by one of those comic opera revolutions, separated from Colombia, and set up an independent republic of its own. How this was accomplished is perhaps a matter of correct

public history—perhaps not. There are critical people yet, who in the blindness of partisan spirit, still decry the alleged actions of the United States at the time of this revolution, but an honest judgment would indicate that this matter should be considered as a closed incident. Regardless of any ethical question involved, there would seem to be times in political history, when the principle of the end justifying the means, would apply. Be that as it may, the practical result was, that the United States was enabled to effect a satisfactory treaty with the new Republic of Panama, failing in which, it would probably have been forced to revert to Nicaragua, if it desired to build a canal, as it had fully determined to do. Among other details of the arrangement with Panama, was the payment, under certain terms, of \$10,000,000 by the United States to the new republic—thus the United States obtained a clear field from all parties interested, by the payment of \$50,000,000.

Under this treaty the United States gained the sovereignty over a strip of land 10 miles in width, 5 miles on either side of the center line of the canal, extending from the usual 3-mile limit in the Caribbean Sea to the same limit in the Pacific Ocean at Panama. This right, however, is not clearly understood by the average man: It is not a fee simple, but it is probably broad enough to answer all purposes.

It grants to the United States power to locate, construct, maintain and forever operate a ship canal, connecting the two oceans, with ample power to establish governmental, including police and sanitary regulations. Excluded from the ten-mile strip are the two cities of Colon and Panama. The power of the United States to regulate sanitary matters, however, extends over these two cities. The United States also has authority, in case it becomes in its opinion necessary, to preserve order, to enter these cities with armed forces and take possession of them. The United States also practically guarantees the Republic of Panama all needed assistance, armed or otherwise, to enable it to preserve its independence.

Since the occupancy of the canal zone by the United States, it has maintained large bodies of police and marines, both in a highly efficient condition, and until about one year ago, kept a war vessel in commission in the harbor of Panama. There is little likelihood of serious trouble, unless as between the two political parties into which

the people of Panama are about equally divided. If, however, the present government of Panama should in its blindness attempt to seriously antagonize our interests, probably another cardboard revolution would curiously enough be pulled off, and a more complaisant government be set up, or, as many declare, the United States would openly assume control of the entire Republic, either by martial law, or by some form of territorial government. Be that as it may, the situation is entirely safe, providing too much is not taken for granted. The ways of the Latin Americans are not our ways, and the entente cordial can best be preserved, by our keeping a paving block close by to drop the hand onto, in case ordinary argument should need a point.

The Act of Congress which authorized the President to proceed with the construction of the canal, placed almost unlimited power in his hands, as to details of route, type and size of canal, the chief limiting clause which, it may be noted, leaves much to his judgment, reading as follows: The Canal "shall be of sufficient capacity and depth as shall afford convenient passage for the vessels of the largest tonnage and greatest draft now in use and such as may be reasonably anticipated."

In order to obtain the advantage of the best engineering advice upon the many general problems involved, the President appointed a board of consulting engineers, the members being eminent in their profession, both American and European. After a visit of inspection to the isthmus and due consultation, the board made two reports, the majority one favoring a sea-level, and the minority a lock plan, both reports, however, concurring in the other general features. After a long time, the whole matter was referred to Congress. The latter body, after examinations and debates, voted in favor of the minority, or lock-level plan—the one under which work is now being prosecuted.

It would require very much more time than is now available to sum up even, the various reasons which the writer believes justify the final decision in favor of a lock canal. He went to the isthmus as Chief Engineer, rather in favor of a sea-level plan, which he abandoned after personal study of the conditions. As he has reason to believe his influence was quite potent in the decision, he feels that this one service to the country is enough for a life time, in helping to save the fatal consequences of a wrong conclusion, as he knows a decision in favor of a sea-level canal would have been.

Briefly expressed, is an extract from a report to the Canal Commission, of date January 26th, 1906, as follows:

"The sum of my conclusions is, therefore, that all things considered, the lock or high-level canal is preferable to the sea-level type, so-called, for the following reasons:

"It will provide a safe and a quicker passage for ships, and therefore will be of greater capacity.

"It will provide, beyond question, the best solution of the vital problem of how safely to care for the flood waters of the Chagres and other streams.

"Provision is made for enlarging its capacity to almost any extent at very much less expense of time and money than can be provided for by any sea-level plan.

"Its cost of operation, maintenance, and fixed charges will be very much less than any sea-level canal.

"The time and cost of its construction will be not more than one-half that of a canal of the sea-level type.

"The element of time might become, in case of war, actual or threatened, one of such importance that measured, not by years but by months, or even days, the entire cost of the canal would seem trivial in comparison.

"Finally, even at the same cost in time and money for each type, I would favor the favor the adoption of the high-level lock canal plan in preference to that of the proposed sea-level canal.

"I therefore recommend the adoption of the plan for an eighty-five-foot summit-level lock canal, as set forth in the minority report of the Consulting Board of Engineers.

"Very respectfully,
"JNO. F. STEVENS, *Chief Engineer.*"

To go back to the time when the United States took formal possession by purchase from the French company and by treaty with Panama: This Commission appointed by the President to supervise

the work proceeded to the isthmus, began the work of organization of the preliminaries, and the thousand and one details naturally pertaining to such an enterprise, received under such conditions, in a tropical climate—and the mention of the latter condition brings us directly to the underlying important feature of sanitation, and the consequent good health of employes without which nothing but failure could result.

Probably no spot on earth previous to two years ago, had—and it largely deserved it—a worse reputation for diseases of various kinds, than Panama. It will never be known how many employes of all colors lost their lives during the French occupancy. Very little was known of modern sanitation, at least very little was practiced by them, and even if their finances had held out, it is probable death and disease would have conquered them in the end. But by the knowledge our army medical men had gained in Cuba as to the true cause and means of preventing yellow fever, that white man's scourge of the tropics has been eliminated, and the percentage of malaria and malarial fevers has been reduced more than one-half. Colon, at the northern, and Panama, at the southern terminus of the canal, were, two and a half years ago, two of the most forbidding, dirtiest, and from a white man's point of view, unhealthiest places on earth. Today, they are and have been for more than a year past, especially Panama, cleaner and more sanitary than the average New England city; paved throughout, provided with modern sewerage and water systems, they are at once a tribute to the energy and intelligence of those Americans who made them possible, and a standing reproach to those Americans who for the sake of a little printed notoriety, have so far prostituted themselves, as to send forth to the world, statements which were not only false, but palpably known by themselves to be false when issued.

This work of sanitation and municipal improvements in these two cities has cost the United States a very large amount of money, which the treaty provides it shall be repaid after a long term of years, and there is a reasonable probability we will be so repaid, but if we are not, the value of this work to us will be four-fold of all that it cost, in the health and life of our employes.

The same careful attention to sanitation has been given to all parts of the zone where our employes, either whites or blacks, work or live, and today the health conditions of the canal zone are better than they

are along lands in the United States bordering on the Gulf of Mexico, and it may be believed the zone is a preferable place of residence. The heat is not intense, as measured by the thermometer, but the humidity is excessive, and without doubt the climate is a trying one on this account, to the average person accustomed to the high latitudes. This objection is provided for, however, by the United States granting to all its employes coming from the United States a six-weeks' yearly leave of absence with pay. This provision, with the practice of ordinary good habits, will carry the average man along in good health, and as safely as he will probably be in the United States.

The Commission at Ancon, near Panama, and at Colon, have large and well equipped hospitals, at which, free of charge, all its employes, white or black, are given the most modern medical care and treatment—all under the charge of experienced doctors and trained nurses. The privileges of these hospitals are not only free to all employes but they are also compulsory, and as a result from month to month, the sick and death rate of the zone per capita, has been gradually decreasing, until now it compares favorably with that of the average American city. Certain diseases, like Typhoid, Diphtheria, etc., have never been prevalent there, and as far as Yellow Fever is concerned, it is now simply a matter of the enforcement of strict quarantine regulations against other, and less fortunate countries, to keep the zone entirely free of it.

The government of the zone is administered by the Canal Commission through one of its members who acts as Civil Administrator, having direction of the courts, police force, schools, post offices, customs, and all the functions which go to make up a well ordered government. Law and order are as well maintained and life and property are as safe, as in well settled parts of the United States. Up to this time, no case is recalled that has been brought to the United States Supreme Court, and possibly the latter has no jurisdiction. There are three circuit court judges, who sitting en banc, form a supreme court. All the judicial and civil machinery has thus far worked smoothly, and it is believed it is well adapted to serve the purpose for which it was created.

The length of the proposed canal, from deep water to deep water, will be about 50 miles, the width varying, as below, these widths as noted being at the extreme bottom of the canal sections:

From the Caribbean Sea, near Colon, 1,000 feet for about 7 miles to Gatun Dam and Locks; from Gatun Locks a minimum width of 1,000 feet through Gatun Lake (to be formed by the Gatun Dam) over a distance of about 26 miles; thence about 2 miles of a width of 500 feet to the north end of Culebra Cut; then 300 feet wide for about 3 miles; then 200 feet for about 4 miles; then 300 feet wide for 2 miles, to the locks of Pedro Miguel, the south end of the Culebra Cut; then through Lake Sosa, some 5 miles, 1,000 feet minimum width, to the locks of La Boca; then 3 miles to deep water in the Pacific Ocean with a width of 1,000 feet.

These dimensions are given in some detail, as showing, from their generous proportions, that a fair rate of speed can at all places be maintained by ships while passing through the canal, excepting through the locks proper, which comprise but an insignificant portion of the entire distance.

A modification of the plans for locks and dams near the southern end of the canal, has been recently made, which will be referred to later on.

A brief study of the map will show, that owing to the peculiar twist of the isthmus, near its narrowest part, the actual direction of the canal is not east and west, as popularly supposed, but from northwest, at the Atlantic end, to southeast, at the Pacific end, and that in fact, Panama, on the Pacific side, is 22 miles east of Colon, on the Atlantic side, so that the use of the terms north and south ends of the canal, is entirely proper.

In formulating the plans for any canal at Panama, the one great overshadowing engineering problem that had to be solved before success could be expected, was the control of the flood waters of the Chagres River, and its large tributaries. This river, rising in the mountains of the Darien country some 100 or more miles east of the canal, flows almost directly west, thence by an abrupt turn, its course changes to the north and northwest, emptying into the Caribbean Sea about 5 miles west of Limon Bay, in which the canal finds its northern terminus. Thus, for nearly 30 miles the canal follows the valley of the Chagres River—a stream which fluctuates in the dry season, from a flow of 600 to nearly 110,000 cubic feet per second, in the rainy season.

At several points along this part of the river, the valley narrows in, and at one point (Gatun) it is less than $1\frac{1}{2}$ miles in width, at an elevation of 100 feet above sea level, and it is at this point, suitable foundations having been found to exist, the gigantic works known as the Gatun Locks and Dam were projected, and are now in course of construction. The dam is to be of earth, will be about 7,800 feet long on top, 100 feet in width on top, and $\frac{1}{2}$ mile wide, or thick, at the bottom. It will be 135 feet high, and will contain approximately 22,000,000 cubic yards of material, the greater part of which will be placed by powerful hydraulic pumps, thus insuring solidity of construction, that only nature under favorable conditions can rival. This material will be clay, with a very slight mixture of fine sand—an ideal material, to produce, so placed, a mass comparable only to a mountain—one that will resist water, decay, earthquake, or any known force of nature or man, within imaginable limits.

It will, by closing up the valley of the Chagres River, form a lake of some 30 odd miles in length, as measured by the main valley, and covering approximately an area of 140 square miles—really a vast inland fresh-water sea; the elevation of the water being at normal 85 feet above mean sea level, this water above the dam, through which passes the line of navigation, being from a maximum of 75 feet to a minimum of 45 feet in depth over the entire distance.

Through the high, natural ground at the east end of the dam will be built triple locks, in duplicate, each lock lifting or lowering, as the case may be, a ship 28 1-3 feet, a total of 85 feet, or the difference in elevation of Gatun Lake, formed by the dam, and the sea-level waters of the Atlantic Ocean which will be brought to the locks by the 7 miles of open, 1,000 feet wide channel, mentioned above. On other very high ground, nearly in the center of the dam, will be constructed the necessary regulating works, by which the height of the water in the lake will be controlled, storing it up for the dry, and allowing it to flow gradually away during the flood periods, as conditions may require.

These regulating works, and the main locks also, will rest their entire length and breadth on rock—not earth; not mud; but rock, really a species of sand rock sufficiently hard to insure first-class foundations, and to set at rest all fears of the stability of the works. That the character of these foundations is first-class, was known long ago to the people directly responsible for them, and had been amply proven by numerous borings and test-pits, but to satisfy a senseless clamor

set up and encouraged by ignorant critics, the Secretary of War—in whose hands next to the President, is the general direction of all canal affairs—took a committee of three of the best known and ablest of our American engineers last year to Gatun. These gentlemen, after a thorough, personal examination, concurred in a report which fully confirmed all previous ones of the Chief Engineer, and which should have settled for all time the questions raised; but very recently the Commission has given out a statement—quite superfluous—that additional borings have been made, and that rock exists everywhere under the proposed locks, and a splendid foundation is assured—another case of the Dutch taking Holland.

The earthen dam will rest on a stratum of impervious clay, nearly 200 feet thick, lying on the same kind of rock that the locks will rest upon. Altogether the foundations of both locks and dam are ideal, and all notions to the contrary can be dismissed from the mind.

The control of the flood waters of the Chagres is simple, and the plan can be easily understood by anyone, whether engineer or not: It is merely accomplished by the formation of a lake, into which the flood waters will pour, at such distances from the sailing line of ships that these flood waters can be entirely ignored. Supposing the Connecticut River rose in flood, and that Long Island Sound, or rather its waters, extended ten miles up the river, from thirty to fifty feet deep, the valley being from $1\frac{1}{2}$ to 3 miles wide: What effect then would the flood in the Connecticut River have on a ship sailing in the Sound, a mile away from the point where the river joined the Sound? None whatever—the ship's people would not know that there was a flood, unless from some slight discoloration of the water. And this is all there is to it—simple of solution, like most problems, when subjected to the analysis of cold common sense, and a remedy of like character applied.

Leaving the lake, the line of the canal enters the famous Culebra Cut, which will be about 9 miles in length, and is directly through the backbone of the Cordilleras—the watershed between the Atlantic and Pacific Oceans. The mountains along the line of the canal rise to an extreme height of some 1200 feet above the sea, and probably it was from some one of these peaks, that Balboa first caught sight of the peaceful ocean, the waters of which ripple as calmly, and which present a view at Panama, which for loveliness is said to rival that of the Bay of Naples.

The bottom of the canal prism in the Cut, allowing for the 40 feet of water, will then be 45 feet above sea level, the surface of the water being the same elevation as that of Gatun Lake, or plus 85. At the highest point the top of the Cut was originally some 280 feet above the bottom, but the French dug away some 120 feet, and now in depth, there are about 120 feet yet to go down. This figure, however, does not adequately express the relative amount of work to be done. When the United States assumed charge of the enterprise, changes in line, increases in width, a more proper adjustment of slopes, etc., which were made, all contributed to swell the total yardage to be moved. An approximate summary of the various items showed about 60,000,000 cubic yards of excavation to be taken from the prism in Culebra Cut, of which probably 80% is rock, of different degrees of hardness, and this vast amount of material was not to be dug out and placed in waste banks immediately alongside of the excavation, but the greater part must be hauled miles by railway trains to find room for disposal.

The work of drilling, of loosening up by blasting, ready for the big steam shovels, while appalling, was only one feature: Hundreds of miles of track must be laid, locomotives by the hundred, cars by the thousand, and all the myriad special adjuncts of shops and machinery, requisite to repair and maintain—all such plant had to be created, and when the writer reached the zone the last day of July, 1905, he thinks he may truly say, he faced about as discouraging a proposition as ever presented itself to a construction engineer.

Passing to the south end of Culebra Cut, the locks and dam at Pedro Miguel are reached. Here, by duplicate locks, with a lift or drop of 30 feet, as the case may be, the change from the 85-foot level, is to be made to the level of Lake Sosa, 55 feet above the level of mean tide in the Pacific Ocean. The plan adopted two years ago was to build two earthen dams at La Boca, near the shores of Panama Bay, closing up the valley of the Rio Grande, in precisely similar manner to the plan adopted at Gatun, thus forming a lake, 4 miles in length, giving a minimum depth of 45 feet of water with a sailing channel not less than 1,000 feet in width. In Sosa Mountain—an isolated rock butte—against which the dams were to rest, two locks en flight, in duplicate, each with a drop of $27\frac{1}{2}$ feet, were to be constructed, thus delivering ships practically into a 3-mile sea-level channel, leading to deep water in Panama Bay and the Pacific Ocean.

Thus the water-way really was to consist of one stretch of canal; then of a long, wide deep lake (Gatun); then throughout a channel (Culebra Cut), of varying widths; then through a smaller lake; and finally through another channel into the waters of the Pacific Ocean. This was practically the plan of the minority of the Consulting Board of Engineers, but has very lately been modified to this extent:

It is now decided to build the dam and locks at the south terminus, some $3\frac{1}{2}$ miles further inland, and thus to extend the sea-level section up and through what has been known as the proposed Lake Sosa. This—particularly if the press accounts are correct—is a wise move. The writer for long months fruitlessly sought by borings to discover suitable foundations for locks and dam at or near Miraflores, the point finally selected. Since that time, however, changes in the plans of the locks, having the effect of dropping the walls and bottom of the same, have rendered sites available now for these works, that a year ago were not tenable; and, too, it is an open question if such changes in the lock plans, if not altogether unnecessary and questionable, have not added millions to their cost, far in excess of any saving in changes of location, and have not added to their efficiency, economy, or safety of operation.

This is a point, however, upon which the writer reserves his judgment, until he is more fully conservant with all the factors in the case. In any event, the best plan should be chosen, regardless of expense within reasonable limits. In regard to this change the writer quotes from the same report made by him to the Canal Commission, referred to previously, as of date January 26, 1906:

“As regards the plan and alignment of the canal at the Pacific end, I am still inclined to my former expressed opinion that, on account of the military and sanitary features, the location of all the locks at Miraflores and Pedro Miguel, instead of part of them at La Boca, with the necessary dam at the same place, will be found more satisfactory; but as the latter plan will cost about \$6,000,000 less to construct than the former one, I am ready to waive my views in favor of the latter plan, although simply on account of the difference in the estimated cost” which shows that the matter was then seriously considered, and that “there is nothing new under the sun.”

The first, or so-called Walker Commission, was unfortunate in many ways, which are immaterial here. The second commission—the

one the writer had to do with—was more fortunate in its make-up, but it had its limitations. When he reached Panama the last of July, 1905, conditions could have been much worse, but they were bad enough. No real start at any effective work on the canal proper had been made, no adequate organization had been effected, sanitary reforms were really just beginning, little new plant had been provided and little that was absolutely necessary had been ordered. In the organization which existed, no co-operation was apparent, and no systematic plans, as far as the writer could discover, had been formulated towards the carrying out of the work along lines promising any degree of success.

And—worse than all, over and above, in the diseased imagination of the disjointed force of white employes, hovered the angel of death, in the shape of Yellow Fever, a number of cases of which were then prevailing, and from which several deaths had occurred. What many of the intelligent men seemed to expect was an order from Washington to abandon the work and go home. To provide housing for this army, to properly feed, to instill into them faith in the ultimate success of the work, to weed out the faint-hearted and incompetent, to create an organization fitting to undertake the tremendous work, and to fill its ranks with the proper material, was a task of heroic proportions. No one will ever know, no one can realize the call on mind and body which was made upon a few for weary months, while all the necessary preliminary work was being planned and carried forward, and no attempt was or could be made to carry on actual construction, until such preliminaries were well in hand. And the only gleams of light and encouragement, were the weekly arrivals of newspapers from the States, criticizing and complaining because the dirt was not flying.

While the French turned over to us square miles of engines, cars, dredges and tools of every description, very few of them were of any value, and those that were used were only used until proper modern ones could be substituted, but as time wore on, as new plant arrived and was put in service, as proper food and housing was provided, as improved health conditions prevailed, as the majority saw that—unconsciously, perhaps, to them—a real, effective organization, working steadily but surely towards a definite and intelligent end, had been made, the whole situation changed for the better; and that the organization was effective, the plant well designed, and all the preliminary work was fairly well done, is evident from the fact that the construction of

the canal since the real beginning, without any addition to plant already in hand or under order, or material change in organization, has gone steadily on, and in amount has surprised the friends and confounded the enemies of the enterprise.

When Congress finally—in June, 1906—decided upon the type of canal, then operations went on faster and faster, and the real start towards digging began in January, 1907, and the amount of work done steadily increased, until in March last, 750,000 and in April 889,000 cubic yards were removed from Culebra Cut—a record which stood until a month ago.

In passing, it is well to say that the date of the completion of the canal depends upon the completion of two items of the work—that of Gatun Locks and that of Culebra Cut, and that some of the yardage now being taken out and reported monthly, while necessarily must be done sometime, could with perfect propriety be deferred, much of it, for four years, thus saving the interest on the cost of such work for the period named, and from a business point of view undoubtedly should be postponed.

Reference has been made to the importance of the Panama Railroad to the work of construction: Lying as it does immediately along the line of the canal, it affords the only practicable means for disposing of the millions of yards of waste material coming from Culebra Cut. Huge systems of tracks have been planned and laid in the Cut, on which are handled hundreds of work trains loaded by the steam shovels with rock and earth, these systems of work tracks being connected at proper intervals with the main tracks of the Panama Railroad, over which the trains run to the dumping ground, or waste banks, some of the latter being 15 miles distant.

A view into and over the Cut from several points is one long to be remembered, and one which has never been seen before: Practically at a glance, one can see from 20 to 40 of the largest steam shovels ever built, dozens of trains, shuttling back and forth, air and other power rock drills by the hundreds, compressor plants, machine shops—all clipping away, with thousands of men black and white, working on the many and varied things there are to do; and over all, hangs a pall of coal smoke that would gladden the heart of a suburban resident, if he could only find some one to complain to about it.

The rejuvenation of the Panama Railroad was one of the hardest problems that had to be met in getting ready to push the canal construction. It had but a single track, practically no sidings or station buildings, a worn out telegraph line, no terminals worthy the name, and motive power and rolling stock that were obsolete 20 years before. While a fair amount of new equipment had been ordered, little or nothing had been done to place the road in proper shape to handle the heavy business suddenly thrown upon it. Traffic, both that pertaining to the canal and commercial, local and through, was nearly at a standstill; thousands of tons of through freight were piled in cars, warehouses, and on docks, and some of these shipments had lain from 3 months to a year and a half, in the hands of the railroad company, and in many cases even the shipping papers and records of this freight had been lost.

All these congested conditions had to be cleaned up, the road rebuilt, reorganized in its operating features and personnel, taking care at the same time of a constantly increasing traffic. All this was accomplished, so that the Panama Railroad one year ago was placed in a condition, both from a physical and operating standpoint, fit to compare favorably with the average of our best American roads.

The creation of Lake Gatun will necessitate the re-location and rebuilding of some 40 miles of the railroad, to place it above the lake level, which work is already under way, and will be completed before the work on the canal proper is done. Meanwhile, the road is handling the canal business, as well as the commercial business, the latter being, however—as it has been for the last two years—badly handicapped by the very inefficient service of the Pacific Mail Steamship Co., whose ships form the connecting link, between it, at Panama, San Francisco and the various ports of call along the Central American and Mexican coast.

Among the great problems that had to be solved, was the securing and care of the vast army of skilled and unskilled laborers, the clerical and supervising forces requisite to carry on the work. The skilled forces were, and are still, recruited in the United States by agencies established here at various points. At first, much difficulty was experienced in securing the right class of men in the requisite numbers, owing to the bad reputation which the isthmus bore, and this

trouble was needlessly continued long months, by the malicious attacks through the press, by some of our American writers, whose motives, to be charitable, can only be ascribed to a morbid desire for notoriety. By patient and intelligent efforts, however, the situation improved, until a year and more ago it became satisfactory, and today the supply of first-class material along the lines of clerical force and skilled labor, is in excess of the demand. The high rate of wages paid, which together with the other privileges enjoyed by these employes, make employment under the Commission, usually much more attractive than any they can secure in the United States.

The supplying of the unskilled labor has been much more perplexing and unsatisfactory. Practically all of this class of labor in the tropics, has for years been drawn from one source—that of the blacks living in the different islands in, and adjacent to the Caribbean Sea, and it is largely from these islands that the present force of laborers is recruited.

Their value as laborers, however, is very low under any condition, and the writer soon found in taking charge of the work, that if the canal was to be completed in any reasonable time, or expense, some other source for obtaining labor must be developed, not only to obtain a better grade and surer supply, but to eliminate the sense of security these people possessed, by the feeling that they had control of the situation by having a labor monopoly. Several plans were discussed and finally an agent was sent to Europe, who after some delay succeeded in directing to the isthmus, through the various steamship companies, a stream of Gallegos, the people living in the Biscayan Provinces of Spain, Italians and Greeks; so that for some time the labor situation has been well in hand as far as numbers are concerned.

The grade is low, and the consequent result will, of course, be a large increase in the cost of the canal, as compared with what the work would cost, if carried out where the best ordinary labor could be procured. The writer favored the introduction of Chinese, whom from personal experience, he knows to be superior from every point of view, but the threads of political necessity sometimes run through the warp even of business, so that from some unexplained reason he was never able to get the authority necessary to carry his plan into effect. The negroes are paid ten cents and the Europeans twenty cents per hour, in gold. There are some 20 odd thousand of the former and prob-

ably 6,000 of the latter, and the net result is that, taking our best white labor here in the United States as a basis of comparison, a day's labor, by reason of lack of efficiency of the blacks, is costing the United States on the canal work at least $3\frac{1}{2}$ dollars, and this will swell the final cost of the canal many millions. The nationality of these laborers, their hours of work, and their rates of pay, have about the same effect on labor in the United States, as if the work were located in the planet Mars, but as political factors, they probably have value.

All employes, white and black, of every grade, are given free of rent, with free lights and fuel, comfortable, furnished houses. The task of supplying all these wants was a tremendous one. While we took over from the French many hundreds of houses of various classes and capacities, all of them had to be rebuilt and made sanitary, and in addition, new dwelling-houses and quarters by the thousands, hotels and eating-houses, hospitals, school houses, court houses, post offices, jails, commissary buildings, fire engine-houses, shops and railway buildings of every description, club houses, and, indeed, the list alone is too long even to enumerate, had to be provided.

On the pay-rolls of the building construction, alone, for two years, were carried more than 4,000 men, and including buildings, docks, etc., there was used in 18 months by the writer over 80,000,000 feet B.M.—equivalent to nearly 6,000 carloads—of lumber, brought from Puget Sound and the Gulf States.

Then, the problem of feeding this army—remembering that it was 2,000 and more miles from its base of supplies—was a great one. After much deliberation, the plan of the Commission of supplying meals to all, excepting those married employes who preferred to keep house for themselves, was adopted, and it has been and is, despite criticism, a great success. Commissary and other needed supplies are sold to employes under carefully-guarded regulations, generally as cheaply, and in some cases cheaper than the same cost us right here in the United States, and about the same class of meals is furnished in the Commission eating-houses for 30 cents, as the average meal throughout the United States is served for 50 cents. Of course, there are and will be complaints. There are complaints in our 5 dollar-a-day hotels here, and there will be so long as time and human nature endures, but the facts are as stated. The record made by the Commission in housing and caring for these employes, is one that can be

pointed to with pride, and no one who was able to, and would work has gone hungry. No Dooley can say as on another occasion: "Well, the glorious war is over, and the byes are starving at Montauk, as they did at Tampa."

As to the length of time necessary to complete the canal: This depends upon many conditions, some of them which may change so as to disarrange all calculations. Two years ago, the writer went on record that the work should be done, and the canal opened by January 1, 1915, and he still holds to this opinion. As before stated, the limiting factors are Gatun Locks and Culebra Cut. No night work has yet been done at either place—at Culebra, while it is possible, it is not advisable; conditions are not such that economical night work there is practicable—nor is it necessary. An average of 1,000,000 yards monthly will complete this Cut in $4\frac{1}{2}$ years, and last month this amount was taken out, but a rate of progress possible now in Culebra Cut, cannot be maintained during the removal of the lower part of the prism for several reasons, but 5 to $5\frac{1}{2}$ years should be ample, and it is not believed that the locks and dam at Gatun can be built in less than that time. They might be, by working night and day, which plan will probably be pursued. Conservatively then, allowing proper time for contingencies, 7 years more should see the canal in operation.

Now, as to its probable cost: All estimates are guesswork, based upon experience gained under conditions similar to the ones under consideration. Without entering into the various discussions of previous or present time, the writer believes \$200,000,000, in addition to those paid the French company and Panama, should fully complete the canal, as well as cover the cost of necessary adjuncts, such as government, sanitation, etc. However, such changes in lock plans, as before mentioned, with others recently discussed, will add millions to this cost, and should not be adopted unless for better reasons than have yet been set forth publicly. From 12 to 30 millions can easily be added by such changes, and so any estimate, until all these factors are fully determined, is largely speculative. In any case, it may be taken as true, if any previous estimates of the cost of the lock type are proven to be too low, *as based on original plans*, then it is absolutely certain that estimates of the cost of a sea-level canal, would have proven also to have been too low, to a very much more marked extent.

The most practicable questions of all to be considered, and the correct answers to which, time only can give, are: Of what benefit

will this canal be to the people of the United States, who are mortgaging themselves to pay for it? And, will it pay, measured in dollars and cents?

Taking then the two values, the military and the commercial: As far as the former is concerned, it undoubtedly will be of some value, but not to the great extent hastily assumed. If the United States is to retain its place among the first-class powers, nothing appears to be clearer, than that it must be as well armed as its neighbors—when they disarm, then we can, and not until then. Peace conferences are all right theoretically, but so far no evidence has been given that anything of value, as looking towards permanent peace, has evolved from them. Indeed, the last one at the Hague, to judge from reports, should rather have been named a War Conference, as it dealt mostly with ways of amending the existing rules, so as to enable war to be made more easily. The United States must, then, maintain a big navy, and, it is believed, two of them—one on the Atlantic and one on the Pacific Ocean.

Nations nowadays when intending to go to war, do not publish their intentions and wait for proposals—they begin to fight and declare war later on—as witness the recent Japanese-Russian fracas. As David Harum said, “find out what the other fellow is going to do to you, and do it to him first” will be the policy, and this view is emphasized, when yearly it becomes more evident that the future great international wars will be fought on sea and not on land.

With the Panama Canal completed, it will take a modern war fleet, moving as a unit, at least 17 days to steam from Hampton Roads to San Francisco, or vice versa; and 17 days is a long time to wait when 13-inch shells are massing up one's front yard. No, the idea that a navy can be thrown from one ocean to another, like a hot potato from hand to hand, does not appeal to a practical mind, and the writer believes that a navy to be of value must be somewhat in the immediate vicinity of the trouble—which will come quickly if it comes at all.

And, too, as the improbable is what generally happens at such times, supposing in case of war with some of our Oriental neighbors, that the enemy's war ships should quietly elude our one wandering tramp fleet, somewhere in the vast expanses of the Pacific Ocean, and

they should capture the Panama Canal, and get control of our coal supply, and war materials. The people of New England have had one vision of a hostile fleet playing hide-and-seek on the Atlantic, and if memory serves correctly, their feelings and actions at the time did not indicate that they are anxiously looking for a similar experience. No, rest assured, our expenditures for a proper naval program will not be lessened, but will rather be largely increased by the Panama Canal, and the necessity for fully protecting it in time of war, by naval, as well as by land defences.

The question of the commercial value of the canal to the United States, is one upon which individual judgment will vary greatly. Without assuming to take decided ground either pro or con, it may be pertinent to call attention to a few points that seem to bear directly on the matter, and which may at least serve to give food for thought to those who may be interested.

No exact records, of course, exist, but as nearly as can be determined, not to exceed 5% of the population of the world lives south of the equator, and not over 1½% live in South America west of the Andes Mountains, and the great majority of these, are people whose wants are primitive, and whose products are insignificant. The great bulk of the people of South America live, and always will, east of the Andes, in Brazil, Argentine Republic, Uruguay, and Paraguay, and all these people, both east and west, are bound by ties of race, of family, of business, to Europe, and east of the Andes Mountains the traffic will gravitate as surely, by reason of the immense navigable rivers and by the systems of railway now being constructed, toward, and to the Atlantic Ocean, as an apple drops from a tree to the ground.

We need no Panama Canal to give us the cream of the business from Venezuela, the Guianas, Brazil, the Argentine Republic: Do we get it? No. Today, if you want to go to Brazil, or any country south of there, you will go first to some European port and take a ship from there to your destination. There is a vast empire which covers southern Ecuador, eastern Peru, all of Bolivia and western Brazil; probably 1,000,000 square miles in extent; unsurpassed in timber, mineral and agricultural wealth, and all practically lying in the water-shed of the Amazon. This river is navigable by ocean ships to the heart of this country, and by light draft vessels to the very foot-

hills of the Andes Mountains. Railways already projected, can and will be built eventually, on water grades to connect with the heads of navigation on numerous streams, and the millions of tons of the products, of this now virgin wilderness, will drop down the Amazon by the cheapest form of transportation, and will have the world for a market. As the writer sees the future, very little of this business can or will be forced up, and over the high summits of the Andes Mountains to find shipping at the western South American ports. Traffic moves along the lines of least resistance, and only a temporary violation of natural laws, can change what appears to be written as the future of South American commerce.

Let us take a concrete instance, which is clearly outside the realm of speculation: The Panama Railroad yearly handles from Panama to Colon about 700,000 sacks of coffee—about 75% of the crop grown in the western part of the Central American States. Only about 20% of this yearly production of coffee comes to the United States—the rest goes to Europe; and this division of the through east-bound traffic on the Panama Railroad is nearly correct when applied to all classes of shipments, even to the west-bound business. The writer, through the Panama Railroad handled all the ships that called at Colon and Panama, or La Boca, its sea-port. There were last year 11 regular lines of steamships doing business at Colon, 9 of them flying a foreign flag, and two of them the American flag, and of these two, one was the Panama Railroad Steamship Co., owned by the United States and employed almost exclusively in handling canal supplies; the other the United States Fruit Company, which did little or no business there. If, then, we are to benefit so greatly in the *future*, by business transported through the Panama Canal, why do we not benefit to a greater extent, *now*, by business coming over the Panama Railroad?

By reason of the canal, we can expect nothing from Africa, nor from Australia, nor from the few scattered, insignificant, from a traffic standpoint, coral islands in the South Pacific Ocean. What, then, is left us? The trade of the west coast of the United States, which we have already; that of Hawaii, the Philippines, China and Japan. Now, what are we going to sell these people, and what will they buy from us that will be routed through the canal?

Coal? We can hardly mine enough now to keep our factories and railroads going and our houses warm, and besides our great unde-

veloped coal resources, lie nearer to the Pacific Ocean than they do the Atlantic or Gulf of Mexico.

Wheat? By 10 years from now, with one-half of the usual yearly increase in our population, not one bushel of wheat will be exported from the United States; if it is, it will go by the way of our Pacific ports.

Lumber? Within a very short time, at the rate we are now exhausting our forests, we will be importing lumber, and already German forestry experts have looked over our probable wants, and are now raising timber in Germany, expecting to sell it to us—as they undoubtedly will.

Iron and iron products? China has iron and coal to a much greater extent than we have, and we can hardly hope to compete with her in her own natural markets, in the face of her cheap labor, even if we could eliminate the cost of thousands of miles of transportation. Enough is known of the immense deposits of coal and iron in China to warrant the belief that with proper development—which is sure to come—of her manufacturing and transportation facilities along these lines, that she will in the future be able to control the markets of the east, and possibly compete with us right here at home.

Cotton and cotton products? Possibly, we may along this line develop considerable trade, but we have to watch the cotton fields of Egypt and Indies, and in the production of bread-stuff, Siberia will some time rival if not outclass the United States and the northwest territory combined.

Hawaii will send us sugar—some of it is now coming by way of the Tehuantepec Railway, recently completed.

What the Philippines can send us, no one can now tell; possibly lumber, jute, sugar and coffee. So far, they have given us nothing in return for vast expenditures, excepting a large and juicy lemon.

China and Japan send us silks, rice, matting, etc., but thus far the ships of the few lines that are plying between our Pacific ports and those of Japan and China, have been run at a loss, excepting two foreign lines, which are heavily subsidized, and altogether the prospect

of enormous shipments to us from China and Japan does not seem to be flattering, unless such shipments are made of raw material, like coal, iron and lumber.

The center of population of the United States is already a long distance west of the Allegheny Mountains, and the cost of transportation from the interior to the Atlantic, and thence over the long route by way of Panama, will undoubtedly be more for most kinds of shipments, than the cost directly over the route by way of our Pacific ports.

And it must not be forgotten that land transportation in the United States has not come to a standstill: Our western railways are becoming more and more a factor, and our Pacific ports of greater importance yearly. Our business will demand, and political and other interests will give way, so that the necessary funds can and will be secured to increase the capacity of the present, and to add new lines, so that as the productions of our factories, our fields, and our mines, increase, so will the means of transportation multiply, and the cost decrease, from the interior to the Pacific Ocean.

A study of the globe will reveal that as comparing the northern with the southern hemisphere, the former contains within itself, by reason of its immensely larger land areas, by far the greater proportion of all that is of material value in the world. The great majority of all that is produced and of all that is consumed, is by people living north of the Tropic of Cancer. Emigration and traffic, therefore, moves largely on parallel lines of latitude, and not of longitude; and just so long as the demand continues as it is now, for faster and faster transportation of every product, whether perishable or not, whether food products or those of iron, of copper, of wood, cotton, lumber, or any other, it is difficult to figure out any great tonnage the Panama Canal will handle, in which the United States will be directly interested.

The case of Europe is different, and the canal will undoubtedly be of large benefit to her—much more than it will be to the United States. Europe has its tenacles fastened upon the trade of western South and Central America—what there is of it. Let a naked native appear on the sea-shore in the tropics with a canoe-load, or a sack of cocoa, or ivory nuts, or of copra, and the chances are good that in a couple of hours the smoke of a German steamer will show up on the

horizon, and his purchaser is at hand—one that does business his way, that caters to his wants, and who does not try to sell him a warming-pan when he wants a pink shirt and a plug hat.

When we learn, as we may, that some form of reciprocity in our commercial laws, some encouragement of our merchant marine, such as is extended to its subjects by other countries, is a necessity, and when we realize—if we ever can—that our belief in our own infallibility and capacity, is not shared by the rest of the world; when we find from bitter experience, that conceit is not the only valuable asset in foreign trade, and that some concessions must be made to secure customers, then possibly, in the distant future, some of the millions going into the “big ditch” will come back to us, and the generations to come will grant to our memories, the tribute of great foresight.

Granting the total cost of the canal will be, exclusive of the interest charge during construction, as it is now claimed, \$300,000,000: The yearly interest on this amount at two per cent. will be \$6,000,000, to which must be added the cost of maintenance and operation, say, \$2,400,000, also a sinking fund of \$10,000,000, to provide at the end of thirty years an amount sufficient to retire the bonds. Thus we will have a yearly charge of \$18,400,000, to be met by gross earnings, which must come from tolls on passing traffic. The Suez Canal was thirty-six years in attaining a yearly traffic of 11,160,000 net tons. This amount of traffic applied to the Panama Canal, with a rate of toll of \$1.50 per ton—the highest rate yet suggested—would give a gross yearly revenue of \$16,740,000—\$1,660,000 less than enough to meet fixed, and operating charges in its thirty-sixth year.

The Suez Canal, opened in 1870, showed a net tonnage the first year of 400,000, which has gradually increased in thirty-six years to 11,160,000 net tons in 1906 (and by net tonnage is meant the actual tonnage on which, under our rules of measurement, tolls would be collected), the average *yearly* net tonnage since being approximately 5,298,700, which at \$1.50 per ton would produce a gross revenue of \$7,948,050, leaving a yearly average deficit, if applied to the Panama Canal, of \$10,451,950, or in 36 years, an accumulated deficit of \$376,270,200, to which may be added, the interest charge—if the \$300,000,000 does not cover it—during the period of construction, making a grand total of \$400,000,000, which must be provided for from other sources than earnings.

Plainly, then, the Panama Canal must handle a larger tonnage each year from the very opening than the Suez Canal did after thirty-six years, as any rate of toll calculated to make it self-sustaining would be simply prohibitory. Still, he is a rash man, who recklessly assumes the role of the prophet as regards the extension, and the possibilities of commerce. We had better trust that the brightest dreams will be realized, and let the coming generations do the worrying about the financial future of the completed canal.

Meanwhile, for any one who has the opportunity and inclination to take a three-weeks' trip from New York, there certainly, in the same time and at the same expense, cannot be found elsewhere in the world, so many things in which every American should take a deep interest, as can be found in a week's visit to the Canal Zone.



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